Continuously operating vertical bag forming, filling and sealing machine

The present invention is directed to a vertical bag forming, filling and sealing machine comprising a feed system for a wrapping material forming the tube bags, a filling tube around which the wrapping material is fed for the formation of a flexible tube and which serves for filling in a material which is to be packed into the tube, a drive means for the wrapping material, a longitudinal seam welding device, a cross seam welding device for the formation of a cross weld seam at a tube bag, a lifting device for the filled tube bag not yet provided with an upper cross weld seam, and a folding device disposed below the cross seam welding device and having two folding members for the wrapping material wherein the lifting device and the folding device are driven in such a controlled manner that, for folding the wrapping material onto the surface of the filling material, the filled tube bag is lifted relative to the folding device and the two folding members of the folding device are moved horizontally inwardly.

A vertical bag forming, filling and sealing machine of the above-cited kind is known from EP-A-1052170. This known machine is a discontinuously operating machine according to which appropriate transport means cyclically move the wrapping material in the form of a flexible tube from above to below. Accordingly, especially during the inward movement of the weld jaws of the cross seam welding device and the folding members of the folding device the wrapping material is not moved further on but takes in a stop position in which the corresponding folding and welding steps can be carried out. Also in this position the filled tube bag is lifted relative to the folding device and the two folding members of the folding device are moved horizontally inwardly in order to press the wrapping material tightly at the surface of the filling material.

The supplied wrapping material is pressed closely and tightly at the surface of the filling material by the inward movement of the two folding members during the simultaneous lifting of the tube bag wherein the air which is present in this range of the tube bag is pressed out. Accordingly, no air cushion remains below the provided cross weld seam.

With this known vertical forming, filling and sealing machine good results are obtained. However, it is clear that this machine cannot produce too high piece numbers of tube bags filled with filling material per unit of time on account of its discontinuous operation.

Accordingly, it is the object of the present invention to provide a vertical bag forming, filling and sealing machine of the cited kind which operates especially fast, however, enables a largely precise folding and welding of the wrapping material in the upper end portion of the tube bag.

According to the invention this object is achieved with a bag forming, filling and sealing machine of the cited kind by the features that the bag forming, filling and sealing machine is designed as machine with continuously moving flexible tube having a device for lowering the cross seam welding device, folding device and lifting device synchronously with the downward movement of the tube, and that the inward movement of the weld jaws of the cross seam welding device and the folding members of the folding device is controlled up to the respective end point such that nearly no relative movement between the weld jaws and the wrapping material takes place at the upper weld jaw contact point with the wrapping material whereafter the cross seam welding device is lowered synchronously with the downward movement of the tube bag.

Accordingly, with the inventive tube bag forming, filling and sealing machine the wrapping material moves continuously downwardly along the filling tube not only during the preparing of the longitudinal weld seam but also during the folding and preparing of the cross weld seam, i.e. the wrapping material is not in a stationary position during the lifting process of the filled tube bag which is open at its upper side, the folding process and the preparing process of the cross weld seam but is

continuously moved further on. A wrapping material drive means serves for the movement of the wrapping material which is preferably formed by one endless belt or a plurality of endless belts which laterally contact the wrapping material guided along the filling tube. The preparation of the longitudinal weld seam can be realized during this continuous movement without any problems with an appropriate longitudinal seam welding device. Such longitudinal seam welding devices are known so that they have not to be described here in detail any more. The present invention is directed to the folding of the wrapping material onto the surface of the filling material contained in the tube bag which is open at its upper side and the preparation of the cross weld seam during this continuous downward movement of the wrapping material. With the inventive solution one succeeds in folding (with lifting the tube bag which is open at its upper side and which is filled with the filling material) the wrapping material onto the surface of the filling material and preparing the cross weld seam without stopping the downwardly moving wrapping material so that the machine can be operated significantly faster than a corresponding discontinuously operating machine with which a corresponding stopping process is necessary.

According the invention the machine is designed in such a manner that nearly no relative movement between the weld jaws and the wrapping material takes place at the upper weld jaw contact point during the inward movement of the weld jaws of the cross seam welding device and the folding members of the folding device up to the respective end

point. This is obtained by synchronizing the downward movement of the wrapping material and the inward movement of the weld jaws and the folding members in a corresponding manner. Since the wrapping material is inwardly moved by the movement of the weld jaws during this period of time a relative movement between the jaws and the wrapping material can be nearly avoided whereby the danger of damaging the wrapping material by the inward movement of the weld jaws is excluded.

Accordingly, with the invention the continuous downward movement of the tube of the wrapping material is not to be affected by the folding and welding processes. Accordingly, with the invention the inward movement of the weld jaws and the folding members is synchronized with the movement of the wrapping material in such a manner that the weld jaws and the corresponding contact point of the wrapping material with the weld jaws move synchronously with respect to one another, i.e. nearly no relative movement between jaws and wrapping material takes place. The word "nearly" which is used here means that an exact synchronous inward movement between the tube of the wrapping material and the weld jaws is substantially impossible in practice so that the inventive teaching also includes corresponding deviations. According to the invention it is the intention to avoid in any case an injury of the continuous movement of the tube of the wrapping material by the welding and folding processes.

When the weld jaws and folding members have nearly reached their inner end point they are downwardly moved together

with the lifting device synchronously with the downward movement of the wrapping material in order to not interrupt the continuous movement of the wrapping material. During this period of time the cross weld seam can be formed and the filled tube bag can be separated. During the following outward movement of the weld jaws and the folding members and the opening of the lifting device for discharging the finished tube bag the wrapping material continues to move downwardly so that even during these processes the continuous downward movement of the wrapping material is not interrupted. This is also the case for the following lifting of the cross seam welding device, folding device and lifting device.

Preferably, according to the invention a single mover is provided which lowers the cross seam welding device, folding device and lifting device synchronously with the downward movement of the wrapping material and again raises the same after the discharge of the finished tube bag packing. This single mover preferably includes a sliding unit which is movable along a rail laterally disposed from the tube axis. A slide unit drive means which is responsible for this movement can be controlled correspondingly in order to obtain the downward movement synchronously with the velocity of the wrapping material and a fast upward movement back into the original position.

Of course, this embodiment is not obligatory. According to the invention more than one mover can be provided either, for instance a mover for lowering the cross seam welding

device and folding device and a mover for lowering the lifting device.

If a single mover is provided, of course, the lifting device can lift the tube bag already filled with filling material and open at its upper side and can lower the same again independently of the movement of this mover for the folding of the wrapping material. As mentioned above, this process takes place during the phase of the inward movement of the weld jaws and folding members wherein the single mover for lowering the cross seam welding device, folding device is in its upper end position in this phase since no relative movement between the wrapping material and the weld jaws takes place on account of the inward movement of the wrapping material caused by the inwardly moving weld jaws. Only after the weld jaws and the folding members have nearly reached their inner end position the single mover begins to lower.

Accordingly, the inventive machine can have a single lowering device for the cross seam welding device, folding device and lifting device or the lowering device can include separate means for lowering the cross seam welding device and folding device on the one side and the lifting device on the other side.

Preferably, the lowering device is designed as slide unit movable along a vertical rail and carrying the cross seam welding device, folding device and lifting device. If separate lowering devices are provided preferably the same

are also formed by slide units movable along vertical rails.

As mentioned above, the lifting device has to be able as such to lift the filled tube bag for folding and to lower the same independently of the movement of the lowering device. It includes preferably a slide unit movable along a vertical rail wherein the rail of the lifting device is disposed at the lowering device. Accordingly, the slide unit of the lifting device can move along the associated vertical rail independently of the movement of the slide unit of the lowering device and its vertical rail. Preferably, the lifting device has two container halves open at the upper side or flaps which are supported at a cross beam supported by the slide unit of the lifting device and which are adapted to be pivoted into an open and closed condition. By pivoting both container halves into an open condition the filled tube bag contained therein can be downwardly discharged by the machine.

The cross seam welding device can produce a single cross seam forming simultaneously the lower cross seam of the upper tube bag and the upper cross seam of the lower tube bag or can produce separately an upper and lower cross seam. In the last case it can have a welding device for preparing the upper cross weld seam and a welding device for preparing the lower cross weld seam. The folding device can be formed independently of the cross seam welding device or can form a unit with the same or can be fixed to the cross seam welding device. Furthermore, the cross seam welding device itself can take over the function of the

folding device so that in this case no separate folding device has to be provided. For instance, the folding device can be formed by the welding device for preparing the upper cross weld seam (with regard to the lower tube bag). In this case by the inward movement of the weld jaws of the welding device for preparing the upper cross weld seam simultaneously the wrapping material is folded onto the surface of the filling material.

It is essential that with the present invention the process of lifting the already filled tube bag which is still open on the upper side for better folding the wrapping material onto the surface of the filling material is realized with a continuously operating machine according to which the wrapping material moves continuously downwardly along the filling tube. This upward movement which is diametrically opposite to the movement of the wrapping material is carried out according to the invention during the phase in which the wrapping material is radially inwardly moved by the weld jaws so that in this manner the additional wrapping material which is necessary for the preparation of the cross weld seam is gained from the continuous downward movement of the same while the additional wrapping material necessary for folding the wrapping material onto the surface of the filling material is gained by the lifting of the filled tube bag with the lifting device. Both processes have been combined according to the invention in such a tricky manner that the continuous movement of the wrapping material is not interrupted and in this manner high piece numbers of the machine are obtained.

For the assistance or improvement of the folding process the inventive tube bag forming, filling and sealing machine can have side folders which move in directions perpendicular with respect to the movement of the cross seam welding device and folding device towards the wrapping material and away from the same and fold the wrapping material onto the surface of the filling material from lateral direction.

The lift carried out by the lifting device has a value of approximately B/2, i.e. corresponds to approximately half of the width or thickness (dimension parallel to the movement of the weld jaws) of the formed tube bag.

As regards the start of the lowering movement of the cross seam welding device, folding device and lifting device, this movement starts preferably shortly before the jaw contact, i.e. shortly before the end point of the inward movement of the weld jaws (end folding members), wherein the movement is brought very fast to the velocity of the wrapping material. As mentioned above, the movement furtheron then takes place synchronously with the movement of the wrapping material.

In the following the invention is described by means of an example in connection with the drawing in detail. Of the drawing

Figure 1 shows a schematic spatial representation of the main parts of a vertical bag forming, filling and sealing machine wherein the jaws

of the cross seam welding device are shown in an inwardly moving condition;

Figure 2 shows a corresponding view as figure 1 wherein the jaws of the cross seam welding device are shown in an outwardly moving condition;

Figure 3 shows a schematic vertical section through the machine of figures 1 and 2 in a condition in which the jaws of the cross seam welding device take in their outer position;

Figure 4 shows a view as figure 3 wherein the weld jaws have approached the wrapping material;

Figure 5 shows a view as figure 3 wherein the weld jaws have been moved inwardly;

Figure 6 shows a view as figure 3 wherein the weld jaws have reached their inner end position and the folding process has been finished;

Figure 7 shows a view as figure 3 in which the lowering device for the cross seam welding device, folding device and lifting device has moved downwardly; and

Figure 8 shows a view as figure 3 wherein the

lowering device has reached its lower end position.

Figure 1 shows the essential parts of a continuously operating vertical bag forming, filling and sealing device which are of interest for the present invention. An appropriate wrapping material 1, which for instance consists of polyethylene, is led around a rectangular filling tube 2 by means of a feed system (not shown) so that a flexible tube is formed. Appropriate transport means in the form of two vertically disposed endless belts 3 move the flexible tube continuously from above to below in the figure. During this movement a longitudinal seam welding device 4 welds together the edges of the wrapping material 1.

With a slight distance from the lower end of the filling tube 2 a cross seam welding device 5 is disposed which serves for the generation of an upper cross weld seam for a lower tube bag and for the generation of a lower cross weld seam for an upper tube bag. On each side of the tube of the wrapping material the cross seam welding device 5 has two superimposed weld jaws which serve for the generation of the upper and lower weld seam. The weld jaws for the generation of the upper cross weld seam form simultaneously a folding device 6 for folding the wrapping material onto the surface of the filling material contained in the lower tube bag. These processes are described in detail later on. Furthermore, the tube bag forming, filling and sealing machine shown in figure 1 includes a lifting device 9 which serves for the receipt of the lower tube bag filled with

filling material and for lifting the same opposite to the movement of the wrapping material. Finally, the machine includes side folders 8 which assist the folding process of the wrapping material from lateral direction.

In figure 1 the machine is shown in a condition in which the cross seam welding device 5 and the folding device 6 are spaced from one another and the corresponding weld jaws or folding members move inwardly towards the wrapping material. Figure 2 shows the machine in a condition after the folding and welding process in which the weld jaws 7 and the folding members have moved again outwardly. In this condition the two flaps of the lifting device 9 have opened so that the finished tube bag packing 10 containing the filling material is discharged downwardly. During the folding, welding and lifting steps the wrapping material 1 carries out a continuous downward movement wherein the operation is described in detail by means of the following figures 3 to 8.

Figure 3 shows the machine in a condition in which the welding device 5 and the folding device 6 take in their outer radial end position with their weld jaws 7 or folding members. In this condition the wrapping material tube extends into the lifting device 9 and is continuously moved further into the same downwardly wherein simultaneously filling material is filled into the tube. Figure 3 shows the condition shortly after the end of the filling step. The two flaps 18 of the lifting device 9 are in the inwardly pivoted condition, i.e. closed condition.

As figure 3 further shows, the weld jaws 7 and folding members are partially movably supported at a slide unit 11 which is vertically movable along a vertically disposed rail 12. The movement of the slide unit 11 is realized by means of an appropriate drive means (not shown). The guide rod of the weld jaws is provided with reference number 16. The slide unit 11 has an upper and a lower portion which protrude in figure 3 to the right and between which another vertical rail 15 is disposed. Along the rail 15 a slide unit 13 is vertically movable. This slide unit supports through a cross beam 14 the two flaps 18 which are pivotally supported by means of appropriate pivot means 17 at the cross beam 14. These parts form the lifting device 9 which serves for lifting the lower tube bag filled with filling material for folding the wrapping material onto the surface of the filling material.

Figure 4 shows a condition in which the weld jaws and folding members have moved further inwardly and already contact the wrapping material 1. The tube has moved further into the lifting device 9 downwardly so that now it is supported by the horizontal portions of the flaps 18. The slide unit 11 is in its upper end position while the slide unit 13 is in its lower end position.

Figure 5 shows a condition in which the weld jaws and folding members have moved further inwardly. In this condition the weld jaws have already pressed the wrapping material inwardly wherein indeed nearly no relative movement between wrapping material and weld jaws takes place since the wrapping material moves further

continuously. During this phase of the inward movement of the weld jaws and folding members the slide unit 13 of the lifting device 9 has already moved slightly upwardly so that the folding or inwardly folding of the wrapping material onto the surface of the filling material can be carried out tension-free with the supply of sufficient wrapping material.

Figure 6 shows a condition in which the weld jaws and folding members have reached their inner end position. In this condition it is now started with the preparation of the upper and lower cross weld seam. Shortly before reaching this condition the slide unit 11 begins with its downward movement. This downward movement has reached the velocity of the downward movement of the wrapping material within short so that the slide unit 11 and the wrapping material are moved downwardly synchronously. In the meantime the lifting device 9 has lifted the filled tube up to the upper end position of the lifting device. All the air from the space above the filling material has been moved out by the inward movement of the folding members and the wrapping material has been folded inwardly onto the surface of the wrapping material.

Figure 7 shows a condition during the downward movement of the slide unit 11 synchronously with the downward movement of the wrapping material. The slide unit 13 of the lifting device 9 maintains its upper end position. During this phase both cross weld seams can be formed.

In the condition shown in figure 8 the slide unit 11 is in its lower end position. The weld jaws and folding members have already moved apart, and the slide unit 13 of the lifting device moves again back into its lower starting position wherein the two flaps 18 have been pivoted outwardly in order to discharge downwardly the finished tube bag filled with filling material 10. Thereafter, the slide unit 11 moves up again, wherein the flaps 18 close again, and reaches its upper starting position shown in figure 3. Now, the next cross weld seams can be generated.

The folding device 6 is fixed to the cross seam welding device 5 by means of height adjusting elements 19 shown in figures 1 and 2. These height adjusting elements 19 enable a height adjustment of the folding device or an adjustment of the distance of the same with respect to the welding device 5. If the folding device 6 is formed by a lower welding device or is fixed at such a welding device a height adjustment of the lower welding device or an adjustment of the distance of the same from the upper welding device is obtained. In this manner the folding device or the lower welding device can be adapted to the height of the level of the filling material.

The side folder 8 shown in figures 1 and 2 has an upper and a lower side folder element. The lower side folder element is disposed relative to the upper side folder element in a height adjustable manner either as this is already the case with the folding device 6.

Of course, the side folders 8 are lowered and lifted together with the welding device 5, folding device 6 and lifting device 9.